Alcohol Affects Emotion And Behavior Through Cognition

John .J. Curtin, Alan R. Lang, Christopher J. Patrick, John T. Cacioppo, & Niels Birbaumer

Abstract

Affect disruption is pivotal to many theories of alcohol use, yet the mechanisms by which alcohol alters emotional response are poorly understood. In the case of threatening stimuli, there are indications that alcohol may attenuate fear by compromising cognitive processes necessary for appraisal of fear cues (Lang, Patrick, & Stritzke, 1999). This experiment further evaluated the hypothesis that alcohol reduces reactivity to threat primarily in complex contexts demanding simultaneous attention to competing stimuli.

Participants received either alcohol (0.08g/100 ml) or no alcohol. They then viewed words from two semantic categories: animals and body parts. Words from one category (CUE+) were followed by electric shocks, whereas no shocks followed words from the other category (CUE-). Words were presented in blocks of 20. Blocks Types were either "Threat focused" (participants simply attended to the words) or "Divided attention" (word cues were colored either red or green, with the color serving as the discriminative stimulus for a speeded Go/No-Go task). Fear-potentiated startle (FPS) to acoustic probes delivered after cue onset was used to assess fear. ERP response (P3) indexed cue processing. Reaction time was recorded to assess task performance.

FPS was observed to CUE+ words, with the magnitude of the effect varying by Beverage and Block Type, such that the greatest reduction in fear occurred in intoxicated participants during cognitive load (Divided attention blocks) that reduced threat cue processing. This diminished fear reactivity was accompanied by lesser RT interference on GO trials involving CUE+ words.

These results suggest that alcohol interfered with cognitive functions necessary for processing of fear stimuli in a complex context requiring attention to multiple cues. Coincident RT effects point to behavioral consequences deriving from this cognitive-emotional effect. Results are consistent with higher cortical mediation of alcohol's effects on fear, and illustrate more broadly how disruption of a cognitive process can lead to alterations in emotional reactivity and adaptive behavior. (Supported by NIMH Grant MH52384)

Multilevel Model of Alcohol Effects on Emotion

- Emotion states entail activation of "action dispositions" that prepare an organism to act.
- Emotional response represents activation of two subcortical primary motivation systems: Appetitive and aversive motivation systems.
- Reciprocal connections exist between these subcortical primary motivation systems and higher level cortical structures.
- Alcohol does not directly affect emotion at the level of these primary motivation systems but instead influences emotional response by its impact on higher level cortical structures.

Methodology

Participants

48 social drinkers (24 male/24 female) assigned to 2 beverage groups
- Alcohol (peak blood alcohol level of 0.080 g/100 ml)
- No-Alcohol

Description of Paradigm

Two Block Types were utilized
- Threat focused blocks: Cues (S1) were from 2 word categories (CUE+ and CUE-). CUE+ trials could result in shock administration. Cue color was constant.
- Divided attention blocks: Cue word category and color varied simultaneously. Task processing was prioritized.

Trial Structure

S1 Identity

- Threat focused: Animal or Body-part
- Divided attention: Animal/Body-part or Animal/Body-part

Dependent Measures

- Fear Response: Fear potentiated startle (FPS) indexed fear response to threat cues in Threat focused and Divided attention blocks. Fear potentiated startle was calculated as the difference in eyeblink reflex magnitude to auditory probes presented after CUE+ vs. CUE- word cues.
- Threat Cue Processing: P3 differentiation indexed attentional resource allocation to threat cue processing. P3 differentiation was calculated as the difference in the P3 component of the event related potential waveform to CUE+ vs. CUE- word cues.
- Task Performance: Reaction time to CUE+ and CUE- GO trials in Divided attention blocks was assessed to examine alcohol intoxication effects on "shock interference" (a slowing in RT on CUE+ relative to CUE- GO trials).

Hypotheses

Fear Response

Differential alcohol effects on fear potentiated startle (FPS) across attentional load conditions
- Reduced FPS in alcohol group in Divided attention blocks
- No beverage group effect on FPS in simpler Threat focused blocks

Threat Cue Processing

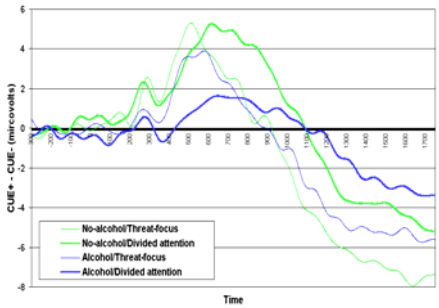
Differential alcohol effects on P3 differentiation across attentional load conditions
- Reduced processing of threat cues in Divided attention blocks
- No beverage group effect on threat cue processing in Threat focused blocks

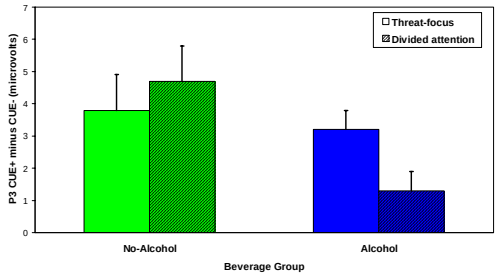
Task Performance

Differential "shock interference" effects across beverage groups
- Reduced interference of shock on task performance in Divided attention block for alcohol group

Threat Cue Processing

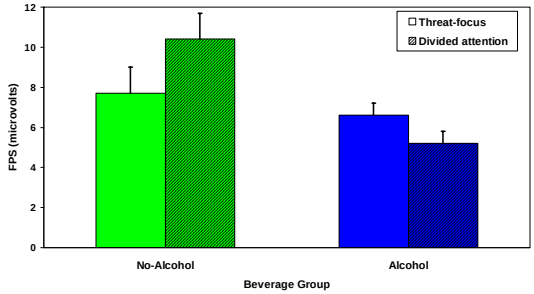
P3 differentiation was analyzed within a Beverage (Alcohol vs. No-alcohol) X Block Type (Threat focused vs. Divided attention) repeated measures ANOVA. A significant Beverage X Block Type interaction was observed for P3 differentiation, $F(1,46) = 4.72$, $p = .037$. Simple effect tests revealed no beverage group differences in P3 during Threat focused blocks. In contrast, P3 was significantly lower for intoxicated participants in Divided attention blocks, $t(46) = 3.55$, $p = .001$. Thus, processing of threat cue information was sensitive to alcohol in conditions of divided attention but not threat focus.





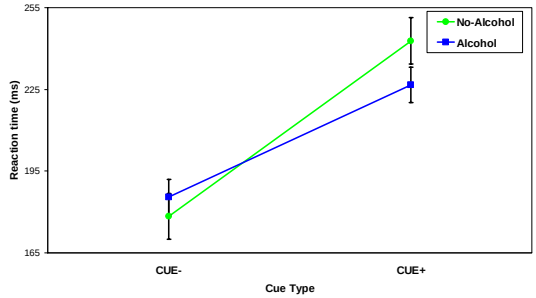
Fear Response

Fear potentiated startle (FPS) was analyzed within a Beverage (Alcohol vs. No-alcohol) X Block Type (Threat focus vs. Divided attention) repeated measures ANOVA. The pattern of results for fear potentiated startle (FPS) mirrored deficits in threat cue processing indexed by P3 differentiation (see previous figure). A significant Beverage X Block Type interaction was observed for FPS, $F(1,46) = 7.91$, $p = .007$. Simple effect tests revealed no beverage group differences in FPS during Threat focused blocks. However, FPS was significantly reduced among intoxicated participants in the Divided attention blocks, $t(46) = 2.36$, $p = .023$. FPS results indicate that alcohol selectively reduced fear response only when participants were required to divide attention between competing stimuli. Reference to P3 results reveals that comparable selective deficits in threat cue processing in divided attention conditions co-occurred and preceded this reduction in fear response.



Task Performance

Reaction time in Divided attention blocks was analyzed in a Beverage (Alcohol vs. No-alcohol) X Cue Type (CUE+ vs. CUE-) repeated measures ANOVA. As expected, a significant main effect of Cue Type, $F(1,46) = 97.28$, $p < .001$, demonstrated that participants did experience shock interference on task performance with RTs significantly longer on CUE+ trials than on CUE- trials. However, more interestingly, Beverage significantly interacted with this Cue Type effect, $F(1,46) = 4.78$, $p = .034$, indicating that the "shock interference effect" (i.e., Cue Type effect) was greater in the no-alcohol group than in the alcohol group



Conclusions

- In divided attention conditions, alcohol-induced global deficits in cognitive processing resulted in impaired processing of peripheral threat cues. In contrast, alcohol intoxication did not negatively impact processing of "prioritized" task-related cues.
- Intoxicated participants exhibited a selective deficit in fear response to threat cues only when required to divide attentional resources between these threat cues and processing of competing task-related information. This deficit in fear response co-occurred with impairment in threat cue processing, strongly suggesting cognitive mediation of this alcohol effect on fear.
- Alcohol intoxication reduced the impact of "shock interference" on task performance. Specifically, intoxicated participants exhibited less reaction time slowing in conditions of shock threat than did sober participants, suggesting that intoxication facilitated task performance in this stressful environment.

UNIVERSITY OF WISCONSIN MADISON